

California Environmental Protection Agency
AIR RESOURCES BOARD

PROPOSED

**CALIFORNIA ZERO-EMISSION AND HYBRID ELECTRIC VEHICLE
EXHAUST EMISSION STANDARDS AND TEST PROCEDURES
FOR 2001 AND SUBSEQUENT MODEL
PASSENGER CARS, LIGHT-DUTY TRUCKS AND MEDIUM-DUTY VEHICLES**

Adopted: _____

Note: This new document is being created to accommodate the modifications to 40 CFR Subpart S being proposed by the U.S. EPA pertaining to certification streamlining for light- and medium-duty vehicles. Most of the text previously appeared in the LDV/MDV TPs. Changes specifically pertaining to LEV II are shown in underline and ~~strikeout~~ to indicate additions and deletions, respectively.

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A. Applicability

The certification requirements and test procedures contained herein are applicable to 2001 and subsequent model-year zero-emission and hybrid electric passenger cars, light-duty trucks and medium-duty vehicles produced and delivered for sale in California. The emission standards contained herein are applicable to 2003 and subsequent model zero-emission vehicles. The general procedures and requirements necessary to certify a vehicle for sale in California are contained in the "California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles" (hereinafter "LDV/MDV TPs"), except as amended herein.

B. Definitions

In addition to the following, these test procedures incorporate by reference the definitions set forth in the 40 CFR Part 86 and the definitions set forth in the LDV/MDV TPs.

"All-Electric Range Test" means a test sequence used to determine the range of an electric vehicle or of a hybrid electric vehicle without the use of its auxiliary power unit. The All-Electric Range Test cycle consists of the Highway Fuel Economy Schedule and the Urban Dynamometer Driving Schedule (see Section F of these test procedures).

"Battery pack" means any electrical energy storage device consisting of any number of individual battery modules or cells that is used to propel electric or hybrid electric vehicles.

"Electric vehicle" means any vehicle that operates solely by use of a battery or battery pack. This definition also includes vehicles which are powered mainly through the use of an electric battery or battery pack, but which use a flywheel or ultracapacitor that stores energy produced by the electric motor or through regenerative braking to assist in vehicle operation.

"Fuel fired heater" means a fuel burning device that creates heat for the purpose of warming the passenger compartment of a vehicle but does not contribute to the propulsion of the vehicle.

"Zero-emission vehicle" or **"ZEV"** means any vehicle certified to zero-emission standards.

"Zero-emission VMT" means the vehicle miles traveled with zero exhaust emissions of any criteria pollutant (or precursor pollutant).

C. Zero-Emission Vehicle Standards.

1. Demonstrating Compliance with the ZEV standards.

1.1 **ZEV Standard.** The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions.

1.2. **Fuel Fired Heater Emission Standards.** Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions. The emissions of a fuel fired heater that operates at ambient temperatures below 40°F shall not be greater than the emissions of a vehicle certified to the passenger car and light-duty truck SULEV standards as set forth in Section E.1.1.2 of the LDV/MDV TPs. If the emissions of the fuel fired heater exceed the applicable SULEV standards, the vehicle shall not certify as a ZEV but shall certify according to the emission level of the fuel fired heater. Vehicles that utilize fuel fired heaters that can be operated at ambient temperatures above 40° F or which cannot be demonstrated to have zero evaporative emissions under any and all possible operation modes and conditions shall not be certified as ZEVs and shall be certified according to the emission level of the fuel fired heater.

2. **Phase-In Requirement.** In 2003 and subsequent model years, at least 10% of a manufacturer's PC and LDT 0-3750 lbs. LVW ("LDT1") fleet (based on the production volume) shall be certified, produced and delivered for sale in California as ZEVs or partial ZEVs according to the following restrictions:

2.1 For large-volume manufacturers, at least 40% of the ZEV requirement must be certified as ZEVs as determined in Section C.1. of these test procedures or as vehicles with a 1.0 total partial ZEV allocation as determined in Section D.2 of these test procedures. The remainder of the ZEV requirement can be met by vehicles meeting the partial ZEV requirements set forth in Section D.2 of these test procedures, however, no more than 40% of the ZEV requirement can be met by vehicles that meet only the requirements of Section D.2.1 of these test procedures.

2.2 An intermediate volume manufacturer may satisfy the total phase-in requirement using only vehicles meeting the requirements set forth in Section D.2 of these procedures.

3. **Implementation Prior to 2003.** Prior to the 2003 model year, a manufacturer that voluntarily produces vehicles meeting the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of

calculating fleet average NMOG exhaust emission values and NMOG credits under Part I, Section E of the LDV/MDV TPs, and calculating ZEV credits as set forth in Section D below.

4. Requirements for Small Volume Manufacturers. A small volume manufacturer, as defined below, shall not be required to meet the percentage ZEV requirements. However, a small volume manufacturer may earn and market credits for the ZEVs it produces and delivers for sale in California.

4.1 The term "small volume manufacturer" shall mean any vehicle manufacturer that produces and delivers for sale in California less than or equal to 4,500 ~~3000~~ new PCs, LDTs, and MDVs per model year based on the average number of vehicles sold by the manufacturer for each model from 1997 to 1999, except as otherwise noted below. For a manufacturer certifying for the first time in California, model-year sales shall be based on projected California sales.

4.2 If a manufacturer's average California ~~sales~~ production volume exceeds 4,500 ~~3000~~ units of new PCs, LDTs, and MDVs based on the average number of vehicles produced and delivered for sale ~~sold~~ for ~~any~~ the three ~~previous~~ consecutive model years, the manufacturer shall no longer be treated as a small volume manufacturer and shall comply with the ZEV requirements applicable for larger manufacturers beginning with the fourth model year after the last of the three consecutive model years.

4.3 If a manufacturer's average California ~~sales~~ production volume falls below 4,500 ~~3000~~ units of new PCs, LDTs, and MDVs based on the average number of vehicles ~~sold~~ produced and delivered for sale for ~~any~~ the three ~~previous~~ consecutive model years, the manufacturer shall be treated as a small volume manufacturer and shall be subject to requirements for a small volume manufacturer beginning with the next model year.

D. Determination of ZEV Credits.

1. **Calculation of ZEV Credits.** A manufacturers that produces and delivers for sale in California more ZEVs than required in a given model year shall earn ZEV credits, which shall be expressed in units of g/mi NMOG. The amount of ZEV credits earned shall be equal to the number of ZEVs required to be produced and delivered for sale in California for the model year subtracted from the number of ZEVs (including partial ZEV allocations) produced and delivered for sale in the model year and then multiplied by the NMOG fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year. In addition, credits earned by meeting the requirements set forth in C.1.1 or D.2 or D.2.1 of these test procedures can only be used to satisfy deficits in later years in the category under which the credits were orginally earned.

1.1. **ZEV Calculation Criteria for 2001 and 2002 Model Years.** In calculating the number of ZEV credits under this subparagraph, each ZEV produced and delivered for sale in the 2001 and 2002 model years may be counted as follows:

| Number of ZEVs | 2001 and 2002 Model Years | |
|----------------|---------------------------|-----------------------------------|
| | Vehicle Range (miles) | Battery Specific Energy (w-hr/kg) |
| 2 | \$ 140 | \$ 60 |
| 3 | \$ 175 | \$ 90 |

1.1.1 For model years 2001 and 2002, additional ZEV credits will be determined by linear interpolation between the values shown in the above schedule. Range shall be determined in accordance with Section F.3.(2)(a) and battery specific energy shall be determined in accordance with Section F.4 of these test procedures.

1.1.2 For purposes of calculating ZEV credits, a ZEV may be counted according to vehicle range or battery specific energy but not both.

1.1.3 For purposes of calculating manufacturer's fleet average NMOG value contained in Section E.2 of the LDV/MDV TPs, each ZEV shall be counted as one vehicle.

1.1.4 All ZEV credits earned prior to the 2003 model year shall be treated as if earned in the 2003 model year and shall be discounted as follows: The emission credits earned in any given model year shall retain full value through the subsequent model year. The value of any credits not used to equalize the previous model-year's debit, shall be discounted by 50% at the beginning of second model year after being earned, discounted to 25% of its original value if not used by the beginning of the third

model year after being earned, and will have no value if not used by the beginning of the fourth model year after being earned.

2. **Determination of Partial ZEV Allocation.**

2.1 **Baseline Partial ZEV Allocation.** In order for a vehicle to be eligible to receive any partial ZEV allocation, a manufacturer must demonstrate compliance with all of the following requirements of this subparagraph 2.1. A vehicle that demonstrates compliance with the following requirements shall receive a partial ZEV allocation of 0.2.

2.1.1 Certify to the SULEV standard at 150,000 miles for PCs and LDTs (0-7300 lbs. LVW) set forth in Section E.1.1.2 of the LDV/MDV TPs;

2.1.2 Certify to the evaporative emission standards set forth in Section ____ of the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles" (zero evap standards);

2.1.3 Certify that the vehicle will meet the applicable on-board diagnostic requirements in Title 13, CCR §1968.1 at 150,000 miles;

2.1.4 Extend the warranty period set forth in Title 13, CCR §§2037(b)(1), and 2038(b)(2) for each vehicle and its components to 15 years or 150,000 miles, whichever occurs first.

2.2 A vehicle that meets the requirements of subparagraph 2.1, above, shall also be eligible to receive additional partial ZEV allocations not to exceed 0.8 by meeting one or more of the following requirements:

2.2.1 **Zero-emission VMT Partial ZEV Allocation.** A vehicle that has zero-emission VMT capability shall receive a partial ZEV allocation, not to exceed 0.6, according to the following equation:

$$\text{Zero-emission VMT Partial ZEV Allocation} = 0.6 \times \text{Zero-Emission VMT Factor}$$

where zero-emission VMT factor is the ratio of the zero-emission miles the vehicle travels to the total miles traveled per trip on average.

(a) Zero-emission VMT factors are calculated as follows:

| All-Electric Range - Urban | Zero-emission VMT Factors: |
|----------------------------|---|
| < 20 miles | 0.0 |
| # 20 miles to < 120 miles | $0.4 + [0.005 \times \text{AER-Urban}]$ |
| \$ 120 miles | 1.0 |

All-electric range - Urban ("AER - Urban") is determined in accordance with the procedures set forth in Section F.(2)(a) of these test procedures.

(b) A manufacturer may request an alternative procedure for prior approval by the Executive Officer to determine the zero-emission VMT potential of the vehicle as a percent of total VMT provided the manufacturer provides an engineering evaluation to substantiate the zero-emission VMT determination. On approval, the Executive Officer shall assign a zero-emission VMT factor not to exceed 1.0.

(c) HEVs equipped with software and/or other strategies that would promote maximum realization of zero-emission VMT potential of the vehicle from off-vehicle charging may qualify for an additional partial ZEV allocation of up to a maximum of 0.1. The Executive Officer shall approve the amount of additional credit based whether the strategy is tamper-proof, effective, or other similar factors.

2.2.2 Partial ZEV Allocation for Fuel-cycle Emissions. A vehicle that uses fuel(s) with very low fuel-cycle emissions shall receive a partial ZEV allocation not to exceed 0.2. In order to receive the fuel-cycle partial ZEV allocation, a manufacturer must demonstrate, using peer-reviewed studies or other relevant information, that NMOG emissions associated with the fuel used by the vehicle (on a grams/mile basis) are lower than or equal to 0.004 grams/mile. Fuel-cycle emissions must be calculated based on near-term production methods and infrastructure assumptions and the uncertainty in the results must be quantified. This partial ZEV allocation is calculated according to the following formula:

Partial ZEV Fuel Cycle Allocation = $0.2 \times (\text{percent of VMT using fuel(s) meeting the requirements of 3.2.2 above})$

A manufacturer must submit test results and/or empirical data supporting the estimate of the relative proportion of VMT while operating on fuel(s) with very low fuel-cycle emissions.

2.3 Calculation of Total Partial ZEV Allocation. The total partial ZEV allocation assigned to a vehicle, not to exceed 1.0, is the sum of partial ZEV allocations earned according to the requirements set forth in 2.1 and 2.2.

2.4 Vehicles receiving the maximum allowable partial ZEV allocation of 1.0 will be considered a ZEV for purposes of the phase-in requirements set forth in Section C.2 of these test procedures.

2.5 The partial ZEV allocation can only be used to meet the phase-in requirements set forth in Section C.2 of these test procedures.

3. **Submittal of ZEV Credits.** A manufacturer may meet the ZEV requirements in any given model year by submitting to the Executive Officer a commensurate amount of ZEV and partial ZEV allocations credits. These credits may be earned previously by the manufacturer or acquired from another manufacturer. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs and partial ZEV allocations produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year.

4. **Requirement to Make Up a ZEV Deficit.** A manufacturer that certifies, produces, and delivers for sale in California fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year by submitting to the Executive Officer a commensurate amount of ZEV credits. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs and partial ZEV allocations produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirements for PCs and LDTs 0-3750 lbs. LVW for the model year in which the deficit is incurred.

5. **Penalty for Failure to Meet ZEV Requirements.** Any manufacturer that fails to produce and deliver for sale in California the required number of ZEVs or submit an appropriate amount of ZEV credits and does not make up ZEV deficits within the specified time period shall be subject to the Health and Safety Code § 43211 civil penalty applicable to a manufacturer that sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the ZEV deficits are not balanced by the end of the specified time period. For the purposes of Health and Safety Code §43211, the number of vehicles not meeting the state board's standards shall be calculated according to the following equation:

(No. of ZEVs required to be produced and delivered for sale in California for the model year) - (No of ZEVs and partial ZEV allocations actually produced and delivered for sale in California for the model year) - [(Amount of ZEV credits submitted for the model year) / (the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model-year)].

6. **ZEV Credits for MDVs, LDTs 3751-5750 lbs. LVW and LDTs 3751-7300 lbs. LVW.** ZEVs classified as MDVs or as LDTs 3751-5750 lbs. LVW or LDTs 3751-7300 lbs. LVW may be counted toward the ZEV requirement for PCs and LDTs 0-3750 lbs. LVW

and included in the calculation of ZEV credits as specified in subparagraph D.1 if the manufacturer so designates.

E. Certification Requirements

1. Durability and Emission Testing Requirements. All ZEVs are exempt from all mileage and service accumulation, durability-data vehicle, and emission-data vehicle testing requirements.

2. Information Requirements: Application for Certification. The certification application shall include the following:

- 3.1 Identification and description of the vehicle(s) covered by the application.
- 3.2 Identification of the vehicle weight category to which the vehicle is certifying: PC, LDT 0-3750 lbs. LVW, LDT 3751-5750 lbs. LVW, LDT 3751-7300 lbs. LVW, or MDV (state test weight range), and the curb weight and gross vehicle weight rating of the vehicle.
- 3.3 Identification and description of the propulsion system for the vehicle.
- 3.4 Identification and description of the climate control system used on the vehicle.
- 3.5 Projected number of vehicles produced and delivered for sale in California, and projected California sales.
- 3.6 Identification of the energy usage in kilowatt-hours per mile from:
 - (a) the battery output (DC energy);
 - (b) the point when electricity is introduced from the electrical outlet (AC energy); and
 - (c) the operating range in miles of the vehicle when tested in accordance with the All-Electric Range Test set forth in Section F, below.
- 3.7 For those ZEVs and HEVs that use fuel fired heaters, the manufacturer shall provide
 - (a) a description of the control system logic of the fuel fired heater, including an evaluation of the conditions under which the fuel fired heater can be operated and an evaluation of the possible operational modes and conditions under which evaporative emissions can exist;
 - (b) the exhaust emissions value per mile produced by the auxiliary fuel fired heater operated at 40°F; and
 - (c) the test plan which describes the procedure used to determine the mass emissions of the fuel fired heater.
- 3.8 All information necessary for proper and safe operation of the vehicle, including information on the safe handling of the battery system, emergency procedures to follow in the event of battery leakage or other malfunctions that may affect the safety of the vehicle operator or laboratory personnel, method for determining battery state-of-charge,

battery charging capacity and recharging procedures, and any other relevant information as determined by the Executive Officer.

3.9 Battery specific energy data and calculations as specified in Section F.4 of these procedures including the weight of the battery system and the C/3 energy capacity.

3.10 Vehicle and battery break-in period (if different than 4,000 miles) as specified in Section F.2 of these test procedures.

3.11 Labeling shall conform with the requirements specified in Title 13, CCR §1965 and the California Motor Vehicle Emission Control and Smog Index Label Specifications.

F. Test Procedures

1. Electric Dynamometer. All ZEVs must be tested using a 48-inch single roll electric dynamometer meeting the requirements of 40 CFR Subpart B, §86.108-00(b)(2).

2. Vehicle and Battery Break-In Period. The vehicle and the battery shall accumulate at least 4,000 miles. In the alternative, for bench aging of the battery, the number of charge/discharge cycles should be equivalent to at least 4,000 miles. A manufacturer may use different break-in periods pending prior-approval by the Executive Officer.

3. All-Electric Range Test. All 2001 and subsequent ZEVs and ~~Type A and Type B~~ hybrid electric vehicles shall be subject to the All-Electric Range Test specified below for the purpose of determining the energy efficiency and operating range of a ZEV or of a hybrid electric vehicle operating without the use of its auxiliary power unit. For hybrid electric vehicles, the manufacturer may elect to conduct the All-Electric Range Test prior to vehicle preconditioning in the exhaust and evaporative emission test sequence specified in the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles" as incorporated by reference in section 1976, Title 13, CCR.

(1) **Cold soak.** The vehicle shall be stored at an ambient temperature not less than 68°F (20°C) and not more than 86°F (30°C) for 12 to 36 hours. During this time, the vehicle's battery shall be charged to a full state-of-charge.

(2) **Driving schedule.**

(a) **Determination of All-Electric Range-Urban.** At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through successive an Urban Dynamometer Driving Schedules (UDDS), 40 CFR, Part 86, Appendix I, which is incorporated herein by reference, until the vehicle is no longer able to maintain the speed or time tolerances contained in 40 CFR §86.115-00(b)(1) and (2). within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedule. A 10-minute soak will follow each UDDS cycle. This test sequence will be repeated until the vehicle is no longer able to maintain either the speed or time tolerances in 40 CFR §86.115-00 (b)(1) and (2). For hybrid electric vehicles, this determination shall be performed without the use of the auxiliary power unit.

(b) **Determination of All-Electric Range-Highway.** At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through a two successive Highway Fuel Economy Driving Schedules (HFEDS), found in 40 CFR, Part 600, Appendix I, which is incorporated herein by reference until the vehicle is no longer able to maintain the speed or time tolerances contained in 40 CFR §86.115-00(b)(1) and (2) within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedule

There shall be a 15 second zero speed with key on and brake depressed between two cycles and a 10-minute soak following the two HFEDS cycles. This test sequence will be repeated until the vehicle is no longer able to maintain either the speed or time tolerances in 40 CFR §86.115-00 (b)(1) and (2). For hybrid electric vehicles, this determination shall be performed without the use of the auxiliary power unit.

(3) **Recording requirements.** Once the vehicle is no longer able to maintain the speed and time requirements specified in (2) above, or once the auxiliary power unit turns on, in the case of a hybrid electric vehicle, the accumulated mileage and energy usage of the vehicle from the point where electricity is introduced from the electrical outlet (AC energy) and the battery output (DC energy) shall be recorded, and the vehicle shall be brought to an immediate stop, thereby concluding the All-Electric Range Test.

(4) **Regenerative braking.** Regenerative braking systems may be utilized during the range test. The braking level, if adjustable, shall be set according to the manufacturer's specifications prior to the commencement of the test. The driving schedule speed and time tolerances specified in (2) shall not be exceeded due to the operation of the regenerative braking system.

4. Determination of Battery Specific Energy for ZEVs

Determine the specific energy of batteries used to power a ZEV in accordance with the U.S. Advanced Battery Consortium's Electric Vehicle Battery Procedure Manual (January 1996), Procedure No. 2, "Constant Current Discharge Test Series," using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in the Appendix of the Manual, including pack(s), required support ancillaries (e.g., thermal management), and electronic controller.

5. Determination of the Emissions of the Fuel Fired Heater

The exhaust emissions result of the fuel fired heater shall be determined by operating at a maximum heating capacity with a cold start at 40°F for a period of 20 minutes and dividing the grams of emissions by 20. The resulting grams per minute shall be multiplied by 3.6 minutes per mile for a grams per mile value.